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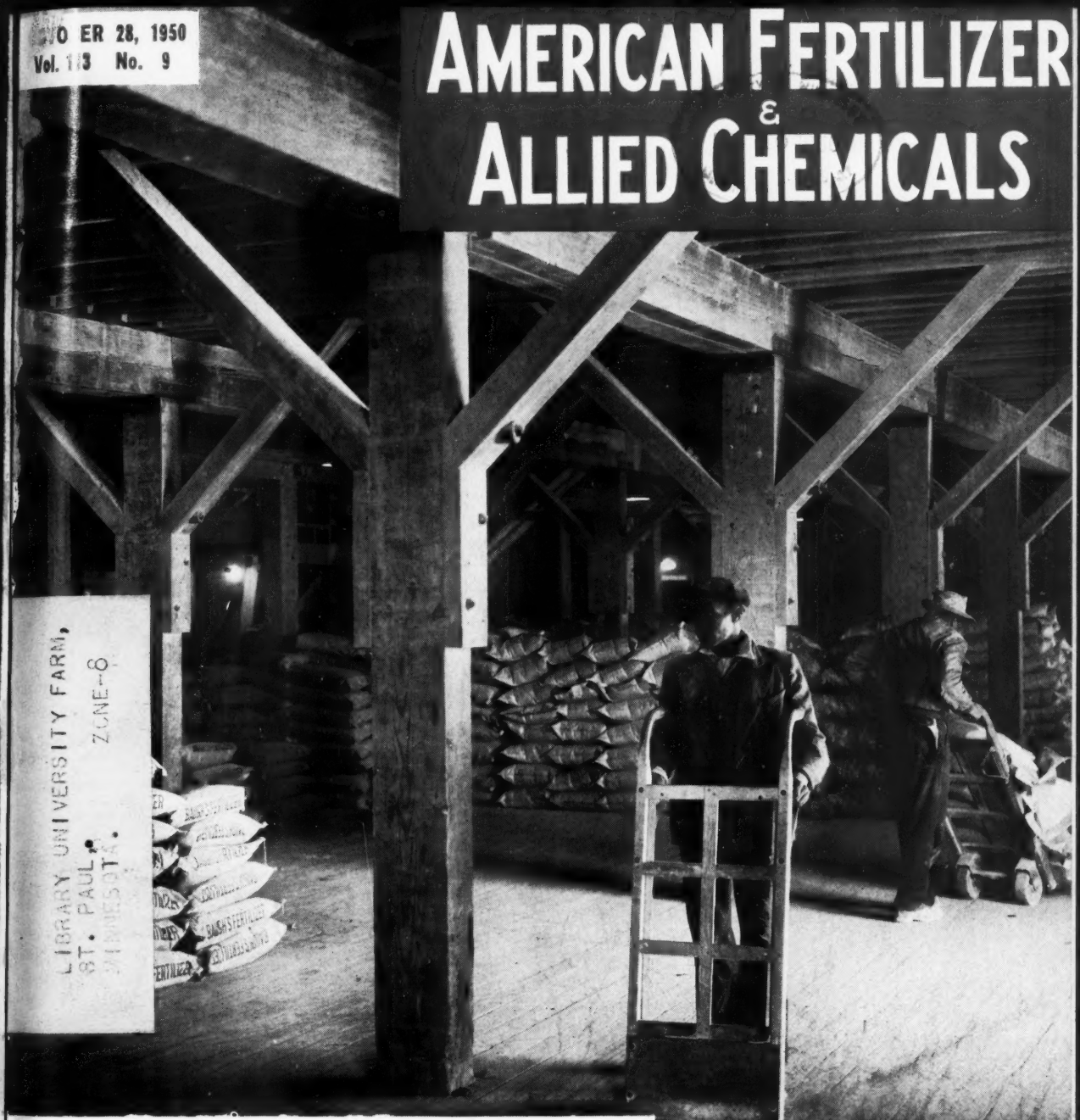
AMERICAN FERTILIZER & ALLIED CHEMICALS



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Cover Story . . .

Bagged fertilizer storage in a Baugh & Sons Company plant. Early movement of the fertilizers to the farm is one of the big objectives for the coming season.

What's Ahead for 1951?

OF INTEREST to most fertilizer manufacturers is the dropping of the potato price-support program for 1951. This action was brought about by the growers in some of the leading potato states who voted not to accept allotment of acreage for this crop; and this automatically did away with the accompanying price support.

As a consequence of this action, the number of acres which will be planted to potatoes next spring becomes problematical. The U. S. D. A. has recommended to farmers that they devote a total of 1,560,000 acres for the production of potatoes for both commercial and farm use. This is a reduction of 15 per cent from the 1950 acreage and under normal growing conditions should produce a crop of about 335 million bushels.

The Department has assigned to each state the number of acres that are so recommended. Compared with the 1950 acreage, this runs from 73 per cent for Maine, New York and New Jersey to 100 per cent for 9 of the least important potato states. The suggested acreage for the leading potato states is as follows: Maine, 95,100 acres (73 per cent); California, 92,900 acres (77 per cent); Idaho, 126,700 acres (86 per cent); New York, 88,400 acres (73 per cent); Pennsylvania, 86,800 acres (89 per cent); North Dakota, 86,200 acres (76 per cent); Michigan, 84,600 acres (87 per cent); Minnesota, 83,800 acres (84 per cent); Colorado, 57,000 acres (89 per cent).

Just how actual plantings will compare with these figures is anybody's guess. The American farmer is an independent sort of person and attempts to predict him, agriculturally and politically, frequently produce headaches for the predicter. The situation presents a knotty problem to fertilizer manufacturers in the potato growing sections and is receiving much serious study.

As regards to the other principal crops, everything seems to be favorable for the farmer in 1951, and hence for the fertilizer manufacturer also. Price support programs for grains, cotton, tobacco and other supported farm products have been announced and in general show little change from 1950. The current cotton crop of less than 10 million bales has caused the government to encourage a substantial increase in acreage and this should result in increased fertilizer tonnage on this crop.

From the fertilizer production standpoint, all signs point to an adequate supply of the principal materials. The industry could use larger amounts of triple superphosphate and the lower priced fertilizer organics if these were available. The wind-up of the Korean campaign has eased somewhat the apprehension that the Army would take for munitions much of the chemical nitrogen earmarked for fertilizer use. Potash and normal super will be sufficient. It remains now to see whether the farmer will take deliveries early and thus avoid the usual spring "bottleneck."

New conclusions as to the behavior of calcium sulphate as a source of

Sulphur and Calcium as Plant Nutrients

By VINCENT SAUCHELLI†

RESEARCH in the nutrition of plants, animals and humans is bringing to light the importance of many chemical elements previously ignored or slighted. This accumulating knowledge forces upon all investigators the necessity of more clearly defining the role of all fertilizer components in the growth and nutritional properties of foods and feedstuffs. Recognizing that crop production is basically a chemical manufacturing process, the investigator as well as the grower needs to know in advance the specific requirements per acre in pounds of each essential plant food to produce a predetermined amount of finished product, the reserves of such plant foods in the soil, and the plant foods to be purchased. Such an inventory of materials—required, on hand, and to be purchased—is the routine procedure of any business. Obviously, it should also be that of the food-growing industry. Therefore, in the preliminary planning, one needs to know the composition of the fertilizers to be purchased, their function and, insofar as possible, the chemical interrelations of the nutrients in the soil to which they are to be applied.

Agronomists now include at least 14 chemical elements in the list of essential plant nutrients. No longer does one think of nutrition in general terms of proteins, carbohydrates, fats and minerals; micronutrients and vitamins are specifically considered an indispensable part of this group. The fertilizer industry no longer confines its thinking to the Big Three—N-P-K—the all-in-all of their offerings. Today, leaders in the industry conceive of a fertilizer as comprising not only N-P-K, but also calcium, magnesium, sodium, sulphur, and micronutrients. Undoubtedly, the fact that scientists have proved that deficiency diseases occur in plant and animal life when soils are seriously depleted of their fertility has brought about this wholesome change in the concept of what a complete fertilizer should contain.

My discussion deals with the role of calcium and sulphur as plant nutrients, and more specifically with their relation to the calcium sulphate component of superphosphate. I shall show that this fertilizer, sulphate of calcium, is identical in its soil behavior with gypsum and that for all fertility purposes the several forms of calcium sulphate are equivalent as a source of calcium and sulphur nutrients and in chemical behavior.

General

Agricultural literature contains many more references to gypsum than to calcium sulphate. This is to be expected since natural gypsum or land plaster has been used on soils as such since the 18th century; and some evidence exists that it was used even by the Romans.

Calcium sulphate may occur as the anhydrate, $CaSO_4$, or as hemihydrate, $CaSO_4.\frac{1}{2}H_2O$, or as the di-hydrate, $CaSO_4.2H_2O$. Gypsum, or plaster-of-Paris, is the di-hydrate form.

When a fluorapatite-containing phosphorite is caused to react with sulphuric acid in such concentration and quantity as to form monocalcium phosphate, the reaction also involves the formation as a co-product of anhydrous, or hemihydrous, calcium sulphate. In other words, when the fertilizer manufacturer causes rock phosphate and sulphuric acid to react, he not only produces superphosphate, but also calcium sulphate in the same operation. Ordinary superphosphate may be considered an almost 50-50 mixture of phosphatic compounds and calcium sulphate, and therefore as a fertilizer is capable of supplying three plant nutrients, phosphorus, calcium, and sulphur. The general process reactions can be represented in two stages, as follows:

$$(1)\quad Ca_{10}P_6O_{24}F_2 + 10H_2SO_4 = 6H_3PO_4 + 10CaSO_4 + 2HF$$

The phosphoric acid acts on the remaining apatite, and we have:

$$(2)\quad Ca_{10}P_6O_{24}F_2 + 14H_3PO_4 + 10H_2O = 10CaH_4(PO_4)_2.H_2O + 2HF$$

These two reactions occur simultaneously. The whole reaction takes place within 10 minutes.

Investigators at the U. S. D. A. (*1*)* have identified the components of calcium superphosphate by means of X-ray diffraction spectra. They found that anhydrous calcium sulphate and monohydrated monocalcium phosphate were the predominant components. They further showed that the hemihydrate or the dihydrate of calcium sulphate could be present in a superphosphate that had aged or if a deficiency of sulphuric acid had

*Figures in parenthesis refer to literature citations found at the end of the paper.

been used in the reaction. It will be helpful to review the analyses of typical normal superphosphate. Two of these follow; one a normal, 20% P_2O_5 superphosphate, old-style, and the other a 20% granulated material:

CALCIUM SULPHATE

	Old-style %	*Granulated* %
Moisture	5	1.5–2.0
Monocalcic phosphate	27–29	29–30
Dicalcic phosphate	10–12	8.5–9.5
Tricalcic phosphate	0.5–1.5	1.5–1.75
Calcium sulphate	45–47	49–51
Iron, aluminum oxides, silicates, etc.	10	10

Granulated 20% superphosphate varies slightly in composition from old-style, but in both the calcium sulphate component is roughly half the weight of the material.

Source of Nutrients

Is there any evidence to support the claim that the calcium sulphate component of superphosphate furnishes calcium and sulphur plant nutrients? Some investigators in the past expressed doubt; but today the agronomic evidence which has accumulated both in our country and abroad leaves no room for doubt. That sulphur and calcium are to be considered essential plant nutrients are also established physiological facts. The evidence of scientific tests supports the statement that calcium sulphate, either in the anhydrous or dihydrate form, does furnish calcium and sulphate ions which can be utilized by growing plants. Some of this supporting evidence will be presented further along.

Some of the old doubt regarding the role of sulphur in plant nutrition stemmed from a curious situation in analytical technique. Many of you chemists are undoubtedly familiar with the history of sulphur determinations in plant ash whereby the first analytical results led to some false conclusions. It bears retelling. One of the early investigators, a German chemist by the name of E. Wolff, published the results of his analysis of the ash of plants sometime between 1870 and 1880 (*2*). These showed that the ash contained a relatively insignificant total amount of sulphur. The conclusion was therefore drawn that sulphur was not an essential nutrient. Later, other investigators found by improved methods of analysis that the sulphur content of plants was substantially higher than that reported by Wolff. W. E. Barlow burned plant material in a tube in the presence of oxygen (*3*). Others determined the sulphur content of plants by the peroxide method. Wolff's method caused heavy losses of sulphur during the process of ashing. The French investigator, G. Bertrand, and his associate, L. Silberstein (*4*), showed that in the ordinary ashing of plant material a great deal of the organic sulphur and some of the sulfate sulphur are volatilized during combustion. Hence, they dissolved organic material in fuming nitric acid to prevent such losses and established a truer figure for the sulphur content of many plants than that previously given by Wolff.

In passing, it may be appropriate to point out that many old analyses of the phosphorus content of plants are also suspect for a similar fault in analytical techniques; that is, in the ashing of the material it was not realized that considerable phosphorus was lost by volitilization.

The following table is presented to give some idea of the sulphur content of representative food plants:

TABLE I

POUNDS OF SULPHUR IN 1,000 POUNDS OF DRY MATTER

Crop	*Pounds Sulphur (S)*
Wheat	
Grain	0.04
Straw	0.5
Oats	
Grain	0.2
Straw	0.9
Corn	
Kernels	0.04
Leaves and Stalk	1.1
Peas	
Seeds	0.4
Straw	1.3
Cabbage leaves	1.0
Horse Radish	2.0
Beets	
Roots	0.1
Leaves	3.4
Turnips	
Roots	0.3
Leaves	4.4

Source: L. Van Slyke, Fert. & Crops, 1912.

As would be expected, the sulphur content, like other nutrient elements, varies with plant species and undoubtedly will be influenced by soil type and fertilizer practices.

At one time it was held that the use of gypsum as a soil amendment would tend to acidify the soil. This view was supported by the old analysis of Wolff. The reasoning was something like this: Since plants apparently do not take up sulphur from the sulphate but do absorb the calcium, the residual sulphate anion accumulating in the soil will tend to create an acid reaction. We know now this is not true. W. B. Bollen (*5*) and Van der Paauw (*6*) have thoroughly investigated this subject and reported that calcium sulphate does not change the soil reaction.

Another consideration to recall is that sulphur deficiency symptoms are not as generally observed as are those of other nutrients. There are reasons for this, as I shall point out. But the absence of strikingly noticeable hunger signs, taken with the other reasonings, previously may have accounted for the belief that sulphur was not an essential plant nutrient. A definite sulphur cycle, however, does exist and it is appropriate briefly to describe its operations.

The sulphate anion in the soil is absorbed through the root hairs and is utilized in the building up of albumen. Animals obtain sulphur from such plant material and they in turn also use it in building up proteins. Albumen and other sulphur-containing substances release sulphur as gaseous hydrogen sulphide in the course of putrefaction, the sulphide passing into the atmosphere. Rains return to the earth a considerable portion of this atmospheric sulphur which soil microorganisms convert to sulphate. Industrial gases and fumes carry some sulphur dioxide into the atmosphere which through precipitation reaches the soil where it is also utilized by microorganisms. Sulfofying bacteria in the soil can generate sulphuric acid from the various sources of sulphur and this undoubtedly has played an important role in the disintegration of mineral particles and even of parent rock

material. A number of investigators have studied this effect of biologically-produced sulphuric acid on rock material and concluded it is of significance (*7*). In some industrial areas the amount of sulphur returned to the soil by rain from the atmosphere is substantial enough to prevent serious depletion for most crops. This source will be entirely inadequate, however, for legumes whose requirements are relatively high. If in such areas no sulphur is returned to the soil by means of commercial fertilizers, a serious deficiency may occur and depress crop yields.

Apparently it is not easy to determine in any area the amount of sulphur accessible to crops. Some determinations reported in the literature give us a very general idea of what to expect. Greaves and Gardner (*8*) and W. O. Robinson and R. S. Holmes (*9*) have shown ranges of sulphur content in some American soils varying from 0.007 to 0.049 per cent, and 0.026 to 0.055 per cent, respectively, or roughly from 140 to 980 pounds, and 520 to 1100 pounds per acre, plough depth, respectively. Some German soils generally have about 0.004 per cent to about 0.09 per cent, which is equivalent to about 120 to 2400 kilograms of sulphur per hectare.

These are total sulphur contents and do not represent the amount actually accessible to the crop. The presence of certain barium compounds in the soil will fix some of the sulphate anions, and the amount of sulphur that soil microorganisms tie up in their bodily tissues is also considerable. With the exception of the sulphate of barium, all other sulphates are more or less soluble in water, which means that a large portion of soil sulphur finds its way into streams through drainage waters. In this connection it is pertinent to refer to the estimates made by Lipman and McLean (*10*) of the annual sulphur losses from soils in the United States: about 5,000,000 tons of sulphur lost in drainage waters with about 50 per cent of this loss made good by sulphur from atmospheric sources. J. S. Jones (*11*) has reported that about 15 pounds of sulphur per acre (16.8 kg. per hectare) would be a three-year average loss from Western Oregon soils through drainage and natural leachings.

Calcium

A. L. Mehring estimates (*12*) that in recent years in the United States about 85 per cent of the total calcium in commercial fertilizers has been derived from normal superphosphates, 10 per cent from dolomite, 1 per cent from natural organics including calcium cyanamid, and 3 per cent from other sources. Fertilizers contain a larger percentage of calcium oxide than any other single nutrient, and in fact the total calcium oxide is almost equivalent to the sum of all the other nutrients together.

So much emphasis has been placed on lime as a corrective of soil acidity that we are prone to slight it as a source of calcium, a nutrient essential to plant growth which cannot be replaced by any other plant food ingredient. Both functions are important, of course. It is the plant nutrient function that I shall emphasize.

I like, therefore, to think of calcium sulphate as a fertilizer because it supplies calcium and sulphur, just as muriate of potash is a fertilizer because it supplies potassium. It has been said that the American diet seriously lacks calcium. There is plenty of evidence in the literature to support that statement. This situation deserves as careful attention as any other nutritional problem. Albrecht in Missouri has shown (*13*) that calcium deficiency in a soil in the humid region is roughly the reciprocal of the increase in soil acidity. He also emphasizes that liming a soil is beneficial much more because it replenishes deficient calcium than because it removes hydrogen ions. To prove this he used a simple demonstration: he grew soybean plants in a mixture of clay and sand to which calcium was added as required to modify the degree of acidity. The plants grew better with higher *p*H. But they also grew better regardless of the acidity, provided they had access to more clay and more calcium.

The relationship between liming the soil and the beneficial effects on plant growth generally is still not too clear, especially to farmers. And yet some of the first observations which led to a more accurate appraisal of the facts were made by farmers. Curiously enough, it was gypsum that in due time made some of the leaders in soil science re-evaluate the role of carbonate in lime. When, for example, Benjamin Franklin demonstrated so dramatically the improvement in the growth of clover produced by an application of gypsum, the soil chemists should have reasoned that the good effect could not have been due to sweetening the soil. Calcium sulphate causes no acid neutralizing effect. Its calcium (and possibly some sulphur) was responsible. The fact that chemical analysis of red clover reveals a relatively high content of calcium and low sulphur should have led to a proper understanding of the role of calcium. Farmers had observed that limestone applied to heavy clay soils improved the yield without changing the acidity. They pointed out that a clover crop derived most benefit from the applied calcium and not necessarily from the correction of acidity. When later it was shown that by dressing a lime-deficient soil with gypsum, or calcium chloride, or even calcium silicate, the legume crop was improved, it was abundantly clear that the improvement could not be attributed to carbonate but to calcium.

Perhaps these observations should also cause us to reconsider what value there is, if any, in making fertilizers "physiologically neutral?" Fertilizer analyses do not show the content of available calcium. If, as previously mentioned, calcium deserves serious consideration as a nutrient in the humid region, whose soils are notoriously low in calcium, should not more attention be given to the presence or not of available calcium rather than to "calcium carbonate equivalence" of the acid producing effect of the fertilizer? I am asking the question, hoping that others more competent than I will give the answer.

(*Continued on page 23*)

Soil-Testing

Lab on Wheels

Photos from International-Harvester

Mounted on special truck by International, the lab on wheels is the first of its kind to be used by an experiment station.

At the rear of the mobile soil-testing unit, Dr. C. C. Murray, director, Georgia Experiment Station, compares notes with Dr. L. C. Olson, while assistant W. K. Walker checks soil acidity.

MOBILE soil-testing units that make possible faster, more accurate analyses are now in use by the Georgia Experiment Station. Mounted on special International trucks, the soils-laboratories on wheels are used for testing in Georgia problem areas.

Interest in soils-testing goes back over 300 years, of course, to the time when science-minded men began to concern themselves with the composition of plants and soils.

The early soil scientists did much to dispel many of the age-old myths that surrounded agricultural phenomen in those days, and, in some parts of the world, still do. The mechanism of nitrogen fixation was explained to everyone's satisfaction only about 65 years ago. At that time it was established that nitrogen fixation occurs in soils even in the absence of legumes with their nitrogen-fixing bacteria, provided that available carbohydrate, phosphate and lime are present.

Today, the techniques of soil analysis are highly formalized, and standard procedures for making various tests have been adopted under the direction of the Association of Official Agricultural Chemists. More and more farmers are becoming increasingly aware of the tremendous variations in soils. To analyze these differences so as to be able to prescribe effective fertilizers, agricultural experiment stations, canning and packing companies, and many fertilizer manuturers have been supplying soil-testing services to farmers for twenty years or more.

Those manufacturers who already have fixed laboratories may find it profitable to add a mobile unit to their facilities. Smaller firms who do not now have their own soil-testing laboratories will, perhaps, find mobile labs the ideal answer to their desire to furnish their customers with the same fast, accurate soil tests now obtainable only through other agencies.

Fixed laboratories can still provide the most accurate and complete analyses, of course, and the significance of mobile soil-testing laboratories lies largely in psychological factors. With mobile laboratories in which soil chemists can wheel up to an individual farmer's fields in person, farm operators are more likely to make wide use of the advice and recommendations the scientists have to offer. Already more than eight states have made inquiries concerning the Georgia mobile unit. ◆

. . . Control Officials at

Washington Meeting

MEMBERS of the fertilizer industry, government workers, and state fertilizer control officials attended the October 6 meeting of the Association of American Fertilizer Control Officials in Washington. The 133 persons who were on hand represented 42 states and the District of Columbia.

Officers for the coming year were elected and several papers dealing with problems of legislation affecting the industry, results of recent research activities, cooperation within the industry, and regional problems were presented.

The importance of promoting uniform and effective legislation, definitions and enforcement of laws relating to the control of sale and distribution of mixed fertilizers and fertilizer materials were stressed by the Association's president, John B. Smith of Kingston, R. I.

"A very important vehicle of travel toward uniformity is the model fertilizer bill," he said. "This has the prestige of a number of years of collaborative effort, and has served as the basis for legislation in several states. Although now in its fifth writing, the bill is a lively document and must be revised frequently to be abreast of technical developments and changing attitudes."

Smith then thanked the American Plant Food Council and the National Fertilizer Association, members of industry, investigators, and control officials for their splendid cooperation.

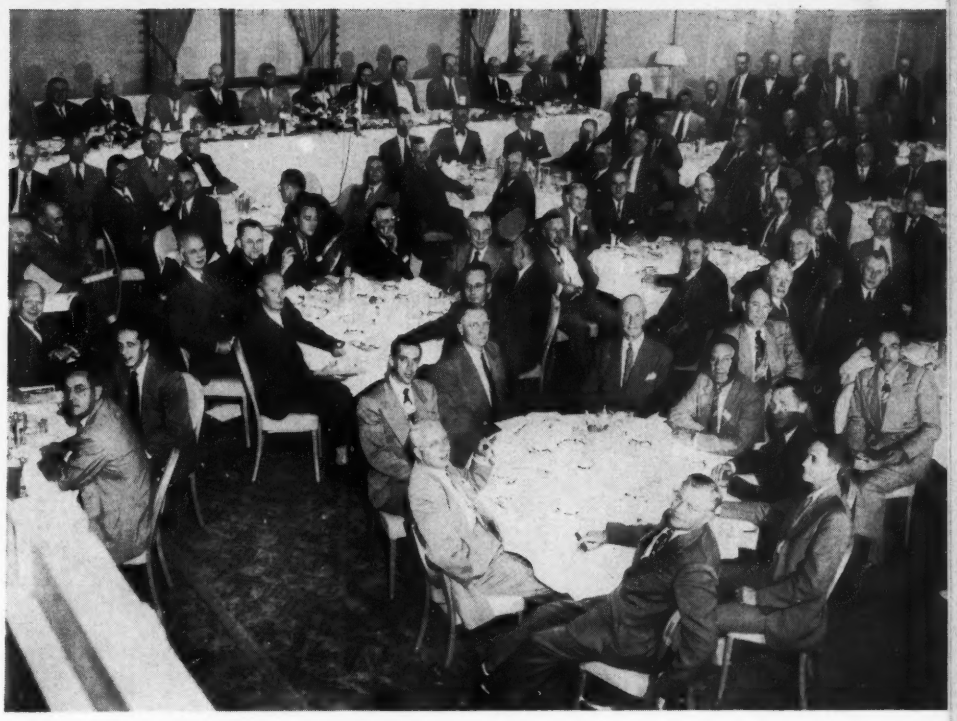
Dr. Russell Coleman, Washington, D. C., president of the National Fertilizer Association pledged the continued support of his organization in the drive for more effective legislation. Coleman, in discussing the present progress of the industry, pointed out that fertilizer production is affected by the movement of box- and tank-cars. He told the group that the fertilizer industry has not been able to increase its storage capacity proportionately with production. No representative of the American Plant Food Council appeared on the program because of the untimely death of the Council's president, C. A. Woodrum.

Dr. Kenneth C. Beeson, USDA, Ithaca, N. Y., presented a paper on the "Comparative Effects of Organic and Inorganic Fertilizers on the Nuritional Quality of Crops." Commenting on attacks that have been made in recent years on commercial or "chemical" fertilizers by proponents of organic fertilizers or composts, Beeson stated that ". . . little, if any, real evidence is offered to support the contention that commercial fertilizers result in nutritional trouble in man.

"It is recognized," he said, "that it is difficult to obtain the truth because of the complications inherent in experiments of this kind. In general the results obtained so far (*from comparative experiments*) do not indicate any important differences in vitamin or mineral content of vegetables grown with compost as compared to commercial fertilizers. If, however, we are to supply an adequate diet for man, we must have an abundant supply of fertilizers."

Regional problems entered the discussions when Dr. H. L. Dunton, head of the Department of Agronomy, Virginia Polytechnic Institute, Blacksburg, Va., presented a paper, "Developing a Pasture Program in Virginia." Dunton stated that there is more interest and enthusiasm in the pasture program than there was in the corn program at a comparable stage of development, and that farmers realize that an intensive pasture program can mean much to the economy of Virginia. He indicated that the pasture program is too large for any one group or agency to handle, and that it is therefore not a program for any one organization or agency in Virginia, but rather the VIRGINIA PASTURE PROGRAM. Close cooperation with the program by the fertilizer industry and other commercial agencies was also cited by Dr. Dunton. As an example, representatives of the fertilizer industry have helped to organize and conduct hundreds of Pasture Tours in the state during the 1950 season. Previously, the industry helped locate and set up pasture demonstrations. Farm machinery dealers in many counties in Virginia are taking their equipment to the fields and preparing and seeding demonstration areas, Dunton reported.

"The History and Present Status



Dinner at the Mayflower Hotel October 5, was given by the National Fertilizer Association. Because of the death of its president, the American Plant Food Council cancelled a dinner it had scheduled for the following night.

of the Magruder Check Fertilizer Sample" was discussed by Dr. S. F. Thornton, director of the Chemical Control and Farm Service of the F. S. Royster Guano Co., Norfolk, Va. Thornton stated that early records exist that make it appear certain that the idea of a monthly check grew out of an informal exchange of samples at irregular intervals among a group of fertilizer laboratories. The records show that the number of analysts cooperating in the check sample has grown from 29 in November, 1922, to 96 at present. Thornton said the "current policy is identical with that announced on November 14, 1922. It is the aim of the sponsors of this work to provide a check sample on which the cooperators may work and to distribute the results of this work so that each participant may have the opportunity to study the results of all other participants to the end that his own methods and techniques may be improved. The need for this service appears to be fully as great today as it was in 1922."

The latest developments in "Insecticides in Fertilizers" were presented to the group by Dr. M. D. Farrar, head of the Department of Entomology and Zoology, Clemson Agricultural College, Clemson, S. C.

"The introduction of chlorinated hydrocarbons as insecticides brought about a new era for the control of insects that feed in the soil," said Farrar. "Previously, sterilization with steam, the injections of fumigants, or the addition of arsenical poisons to soils were used. These methods were unsatisfactory due to high cost and low efficiency. At best, they proved only partially effective and repeated treatments were often necessary."

Farrar further stated that "Fields treated with insecticide-fertilizers have, in many cases, shown tremendous response by way of increased crop standard production. Farm demonstrations have been so outstanding that farmers have requested the fertilizer manufacturer to mix insecticides with their fertilizers, but this practice is not in conformity with fertilizer laws or regulations.

"To permit the addition of insecticides to a fertilizer mixture," Farrar told the meeting, "several states have now issued regulations governing the added chemicals in the mixture. Generally the regulations require the bags to be marked or tagged to show the weight of chemical added to each bag."

Other papers presented to the group included the "Composition of Mixed Fertilizers in Relation to Guarantees," by Walter Scholl, USDA, Beltsville, Md.; and "The Reporting System vs. Tax Tags," by L. C. Jacobs, Supervisor, Feeds, Seeds and Fertilizers, Nashville, Tenn. Copies of these papers, as well as the entire texts of the papers reported on above will be available in the January, 1951 edition of the *Journal of American Fertilizer Control Officials.*

Officers elected at the meeting for 1950–1951 were:

President, **R. C. Berry,** Richmond, Va.; Vice-President, **J. F. Fudge,** College Station, Texas; Secretary-Treasurer, **B. D. Cloaninger,** Clemson, S. C.

The Executive Committee includes the President, Vice-President, Secretary-Treasurer, the retiring president, and: **W. S. Thopmson,** Columbus, Ohio, 1953; **G. W. Michael,** Ottawa, Canada, 1953; **J. D. Patterson,** Salem, Oregon, 1951; **Parks Yeats,** Chairman, Oklahoma City, Okla., 1951.

◆

Industrial News Notes

Barrett Opens Sales Office at South Point Plant

Ohio air grows sugar in Cuba, oranges in Florida, watermelons in Georgia, cotton in Alabama, tobacco in Kentucky, wheat in Indiana, corn in Iowa, apples in Michigan, potatoes in Maine and grain in Canada. In fact, the nitrogen in Ohio air is used to grow most every kind of crop in the Eastern half of the United States.

One of the largest nitrogen plants in the country is located on the Ohio River at South Point, Ohio. Through chemical magic, this giant chemical plant, owned and operated by The Solvay Process Division, Allied Chemical & Dye Corporation, extracts nitrogen from the air and combines it with other elements to make the various forms of Barrett Nitrogen so useful to agriculture and industry. The rated production capacity of this industrial giant is over 500 tons of actual nitrogen daily—enough to grow one-half million bushels of corn

The principal forms of fertilizer nitrogen manufactured at South Point, are: Barrett Ammonium Nitrate-Ammonia Solutions, Barrett Anhydrous Ammonia and Barrett Standard Urea Fertilizer products.

The South Point Plant was built during the early part of World War II to produce anhydrous ammonia to supply war needs. Soon after the close of World War II, the South Point Plant was purchased by Allied Chemical & Dye Corporation and since has been producing various Barrett Nitrogen products for American agriculture and industry. Thus this great war plant has become a tower of strength in the American post-war recovery program. And the production of nitrogen at South Point, along with other nitrogen fixation plants, has helped to make America independent of foreign sources of nitrogen.

The South Point plant is strategically located to effectively serve expanding nitrogen fertilizer needs in the Midwest, and surrounding territory. Corn belt soils are fast becoming nitrogen-hungry. It is estimated now that over 70 per cent of the corn grown in the Midwest is nitrogen-starved.

To serve the Midwest region, the Barrett Division recently opened an Agricultural Development and Sales office at South Point.

NFA Fall Meeting

This year's fall meeting of the National Fertilizer Association will be held November 13–15 at the Edgewater Gulf Hotel, Edgewater Park, Mississippi. More than 400 members of the industry are expected to be represented.

Topics relating to the future of American agriculture will be discussed by business, agricultural and government leaders. Speakers will include Norris E. Dodd, director-general of the Food and Agriculture Organization of the United Nations; Robert Lee Humber, Greenville, N. C. attorney; and J. E. Totman, president of the Summers Fertilizer Company, Baltimore, Md., and Chairman of the Board, National Fertilizer Association.

A panel of the pros and cons of high-analysis fertilizers, with J. F. Fudge, state chemist, College Station, Tex., as moderator, will be a special feature of the program. On the panel will be Maurice H. Lockwood, vice president, Plant Food Division, International Minerals and Chemical Corporation, Chicago; A. F. Miller, general sales manager, Plant Food Division, Swift and Company, Chicago representing the fertilizer industry; with Ivan E. Miles, extension agronomist, State College, Miss., and H. L. Dunton, head of the Department of Agronomy, Virginia Polytechnic Institute representing the agricultural colleges.

Tri-State Organization Formed on West Coast

Because their soil problems have been increasing during the last few years, fertilizer manufacturers in three states—Washington, Oregon and Idaho—recently organized the Pacific Northwest Plant Food Association during a meeting October 18, in Seattle.

One of the main working bodies of the Association will be its Soil Improvement Committee, consisting of a chairman and six technical experts from the fertilizer industry and six soil scientists, two from each of the three state colleges.

This committee's function will be to encourage soil testing and plant tissue analysis—needed to make sound fertilizer recommendations.

George A. Wickstrom, field agronomist of the American Potash Institute, Sumner, Washington, is chairman of the committee, and the state colleges will be represented by: Washington State College, Dr. B. R. Bertramson, chairman of the De-

partment of Agronomy, and Karl Baur, soil scientist at the Western Washington Experiment Station, Puyallup: Oregon State College, R. A. Pendleton and L. E. Warner; Idaho University, G. O. Baker and V. T. Smith.

The six industrial representatives elected were: G. E. Bruington, Swift and Company, Portland, O.; G. J. Arens, Pacific Supply Cooperative, Portland, O.; J. L. Wursten, Simplot Soil Builders, Idaho Falls, Idaho; N. W. Hibbert, Anaconda Copper Mining Company, Yakima, Wash.; L. G. Judson, Lynden Department Store, Lynden, Wash.; and G. A. Huber, Oregon-Washington Fertilizer Company, Puyallup, Wash.

Headquarters of the three-state Association will be in Portland, O. Officers of the Association were elected as follows: G. A. Fitzpatrick, Pacific Supply Cooperative, Portland, O., president; Henning Waltersdorph, Magnolia Fertilizer Company, Seattle, vice-president; Alec Runciman, Webb-foot Fertilizer Company, Portland, treasurer; Leon Jackson, Portland, secretary; and E. B. Shipley, Swift and Company, Portland; and Mac C. Taylor, Oregon-Washington Fertilizer Company, Seattle.

Quarterly Earnings

Net sales of **International Minerals and Chemical Corporation** for the three months ended September 30, 1950, totaled $11,500,292 as compared with $10,208,702 for the same period last year, an increase of 13 per cent.

Net earnings for the three-month period were $943,366 as compared with $805,627 for the corresponding period a year before, an increase of 17 per cent.

Earnings per common share for the three-month period were $1.07 per share as compared with 89 cents per share for the same period a year ago, with 792,030 common shares outstanding.

Commercial Solvents Corporation reports, for the quarter ended September 30, 1950, consolidated net profit of $1,504,221, equal to $.57 a share on 2,636,878 shares; for the corresponding quarter of 1949 net profit was $919,521, equal to $.35 a share; provision for Federal income taxes for the third quarter of 1950 was $1,160,800, which compares with provision of $513,200 for the corresponding quarter of 1949.

For the nine months ended September 30, 1950 net profit was $2,823,131, equal to $1.07 a share, after adjusting previously reported six months earnings by $57,100, equal to $.02 a share, due to increase in Federal income tax rates; for the corresponding period of 1949 net profit was $2,483,278, equal to $.94 a share; provision for Federal income taxes for the first nine months of 1950 was $1,996,700, which compares with provision of $1,404,400 for the corresponding period of 1949.

New Pennsalt Plant at Montgomery, Ala.

A new plant for the blending, formulating and production of agricultural chemicals is being installed by the Pennsylvania Salt Manufactring Co. at Montgomery, Ala., it was recently announced.

From this new plant, Pennsalt will make available to growers in the Southeast a complete line of agricultural chemicals for use on cotton, peanuts, soybeans, potatoes and other crops and on livestock.

Many of the products, the Company reported, will be new additions to Pennsalt's line and several will be produced by a unique

(*See News Notes, page 20*)

September Tag Sales

Combined tax tag and fertilizer shipment statistics from 12 southern and midwestern States show that September figures were approximately 4 per cent higher than those of the same month last year. The National Fertilizer Association, which compiles the statistics, reports that during the first eight months of 1950, the South reported a total of 6,665,000 equivalent short tons, or about 4 per cent more than during January-August of last year, while the 3 midwestern States recorded 1,483,000 tons, or a gain of 19 per cent over the corresponding 1949 total. During the first 2 months of the current fiscal year, the South, with a total of 385,000 tons, surpassed its year-ago figure by more than 20 per cent, while the Midwest tonnage rose by the same percentage from 270,000 to 326,000.

FERTILIZER TAX TAG SALES AND REPORTED SHIPMENTS

(In Equivalent Short Tons)

Compiled by The National Fertilizer Association

	September		*January-August*		*July-August*	
State	*1950*	*1949*	*1950*	*1949*	*1949–50*	*1948–49*
Virginia	34,624	56,228	559,517	540,697	47,735	46,710
N. Carolina	*	53,245	1,459,538	1,284,572	34,744	23,686
S. Carolina	50,340	35,435	739,835	785,089	34,220	22,517
Georgia	40,667	44,300	983,576	1,031,873	27,271	15,451
Florida	78,161	53,677	652,435	593,405	82,287	77,942
Alabama	22,137	17,179	870,513	912,174	46,218	35,322
Tennessee	29,056	18,105	397,240	377,680	24,502	16,948
Arkansas	6,303	7,390	313,265	283,961	23,135	16,784
Louisiana	11,496	8,665	217,306	197,731	12,825	12,586
Texas	56,275	47,547	370,489	322,220	38,959	32,372
Oklahoma	*	24,121	101,027	87,759	12,715	16,749
Total South		365,892	6,644,741	6,417,161	384,611	317,067
Indiana	42,379	49,195	638,419	542,379	172,930	177,059
Kentucky	13,670	26,646	463,124	364,776	63,717	40,107
Missouri	74,037	77,305	381,764	339,465	89,049	53,058
Total Midwest	130,086	153,146	1,483,307	1,246,620	325,696	270,224
Grand Total		519,038	8,148,048	7,663,781	710,307	587,291

*Not available at this time.

Prof. Collings

Better Men through Better Uses of Better Fertilizer

BECAUSE Uncle Sam is now in the process of rearming against aggression, fertilizer manufacturers, along with other manufacturers of the country, are already feeling and will continue to feel the pinch of a shrinking labor market." That is what Gilbeart H. Collings, professor of soils at Clemson College told members of the Plant Food Educational Society of South Carolina at their recent organizational meeting.

"The effects resulting from the drafting of a few million men will probably be felt in some areas to a greater extent than in others. The experiences of World War I and World War II would lead us to believe that rejections among draftees will be higher in the southeastern states even though commercial fertilizers are so extensively employed there. Educated people," he said, "are beginning to concern themselves with the nutritive quality, as well as the quantity and price of the food they buy.

"In many cases, malnutrition among crops is so widespread that it is taken for granted," maintained the Professor. Singling out their home state as the focus of his remarks to the new South Carolina trade association, Collings went on to say ". . . nutrient deficiency symptoms are so prevalent in the cultivated crops of South Carolina that if these hungry crops could cry like a baby, the howl that would go up would make our conversation impossible."

Collings interpreted this as a reason for increasing the use of better fertilizers. ". . . the need is almost unlimited," he said. The soils of South Carolina are shy in nutrient value in spite of the fact that farmers in that state now use nearly a million tons of fertilizer annually. Professor Collings thinks the amount should be doubled.

Methods by which soils of low fertility can be converted into fertile, productive lands are slowly being worked out and put to practical use. The fertilizer industry, believes Collings, should be interested in promoting any sound program directed toward and strengthening the economic condition of the farmer. Also, he said the industry should be extremely interested in every program designed to inform the farmer as to the proper use of the fertilizers sold to him. In other words, thinks Collings, the fertilizer manufacturer should help the farmer make as large a profit as possible from the fertilizers he buys. "A successful farmer," declared Collings, "is a good fertilizer customer."

The professor then advised the newly founded Plant Food Educational Society to help improve the general financial rating of the farmer Although the ways in which the group can help the farmer directly are limited, one way Collings thinks educational groups can help is by encouraging the farmer to apply the latest research findings as to the quantity and proper use of correct fertilizers. Education, however, is a slow and costly process, the Professor told the group.

(*Continued on page 18*)

BONE MEAL TANKAGE BLOOD
SHEEP—COW—POULTRY MANURE
CASTOR POMACE NITROGENOUS
GROUND TOBACCO STEMS HOOF MEAL
ALL FERTILIZER MATERIALS
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FERTILIZER MATERIALS MARKET

NEW YORK

Chemical Nitrogen Production Well Contracted For. Demand Increases for Castor Pomace and Nitrogenous Tankage. Rise in Superphosphate Prices Expected Shortly. Box Car Shortage Threatens

NEW YORK, October 25, 1950

Sulphate of Ammonia

No price changes were reported and demand continued good from domestic as well as export buyers. Most producers were sold up for the coming fertilizer year.

Nitrate of Soda

A little better demand was noted from some sections for this material but supplies were adequate to take care of demand.

Ammonium Nitrate

Demand continues excellent for this material with producers sold out. In some cases shipments are slightly behind, due to production difficulties.

Castor Pomace

With last sales of this material at $37.50 per ton, f.o.b. production point, and with one producer quoting the material on a unit basis of $5.50 per unit of ammonia ($6.68 per unit N), this material was finding favor among buyers, due to the shortage of similar materials.

Nitrogenous Tankage

This material is hard to obtain for prompt shipment unless a buyer has a contract with one of the producers. Prices remain very firm at from $4.10 to $5.50 ($4.98 to $6.68). according to shipping point.

Organics

Organic fertilizer materials showed a mixed tone, with some materials in excellent demand and others showing an easier tendency. Tankage and blood were quoted at $7.50 to $8.00 ($9.12 to $9.72 per unit N), f.o.b. Eastern points according to quality and test. Linseed meal was slightly easier in price for nearby shipment at from $53.50 to $61.00 per ton in bulk according to shipping point. Soybean meal was quoted at from $51.00 to $52.00 per ton in bulk, f o.b. Decatur, Ill. The cost of bags was increased from $5.00 to $5.50 per ton. Cottonseed meal was quoted in bags at $69.00 per ton, f.o.b. Memphis, Tenn.

Fish Meal

Few sales were noted of this material at $130.00 per ton, f.o.b. Eastern points in spite of the fact that the fishing season for menhaden has come to an end. Various lots of imported fish meal could be obtained at comparative prices.

Bone Meal

No price changes were noted, with demand good from both the fertilizer and feed trade. Some inferior grades of foreign material have been offered but most buyers prefer domestic material for the small difference in price.

Hoof Meal

This material has maintained a firm tone with last sales made on the basis of $7.25 per unit of ammonia ($8.82 per unit N), f.o.b. Chicago. Stocks in producers' hands are said to be very light.

Superphosphate

It has been reliably reported that leading producers will raise the price of regular superphosphate around January 1st because of increased costs, including sulphur and sulphuric acid. Most buyers are anticipating this by taking in the material at this time. Triple superphosphate is still behind the demand and scarce.

Potash

All the producers of this material face a possible box-car shortage at times; shipments are moving pretty much on schedule and production is being maintained. No further sales of imported potash were reported.

Garbage Tankage

Most producers of this material are sold ahead with very little material available for prompt shipment and prices firm.

PHILADELPHIA

Market Not Particularly Active. Chemical Materials in Adequate Supply. Organics Market Quiet

PHILADELPHIA, October 25, 1950

Inquiries for raw materials in general are not too active. Nitrate of ammonia and converter's sulphate of ammonia are in very tight supply but no very serious scarcity is apparent. There is good inquiry for nitrogenous tankage, which is exceedingly scarce. Blood and tankage are a little easier. Shortage of sulphuric acid may later reflect some inconvenience in the fertilizer trade.

Sulphate of Ammonia.—Demand is fair for domestic use and inquiries are being supplied without difficulty. Converter's grade for export is quite tight. Due to scarcity of ammonium chloride, it is thought some consumers may turn to sulphate of ammonia. Market is firm and some producers whose prices were below the average range have now advanced them.

Ammonium Nitrate. — This remains in very tight supply with production well under contract.

Nitrate of Soda.—Market is firm with no price changes reported, and supplies are ample for all requirements.

Blood, Tankage, Bone.—Blood and tankage are rather quiet and quoted $8.00 to $8.50 per unit of ammonia

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($9.72 to $10.33 per unit N), being a little stronger in the West than here. Bone meal is in fair supply and rather inactive, and can be had at a reduction with firm bids.

Castor Pomace.—Supply is quite limited, with production under contract. Last price is reported as $37.50 per ton at producing plant, carloads.

Fish Meal.—Market is steady with no price changes indicated and not much offering. Quotations in Baltimore area were $130.00 per ton for menhaden meal.

Phosphate Rock. Supply is reported well able to meet the demand and contract shipments are moving along in normal fashion. Price position is steady.

Superphosphate. While the triple grade is in tight supply, stocks of normal are fully able to meet all requirements. It is a question whether sulphuric acid may become sufficiently scarce to affect the production of this article.

Potash.—Inquiry continues strong and production is at capacity. Box car shortage is intermittent and not too serious to date. Recent increase of two cents per unit for spot muriate. applying as it does to only a limited tonnage, should not materially affect the cost of complete mixtures.

CHARLESTON

Prices on Materials Show Tendency to Increase. Shortage of Sulphuric Acid Hurts Superphosphate Production

CHARLESTON, October 21, 1950

Superphosphate during the coming season is expected to be very firm in price and possibly supply slightly short of demand, due to the tight position of sulphuric acid which is necessary for the production of superphosphate. Other fertilizer materials are in firm market position with prices tending upward.

Organics.—The market on organics continues firm and those suitable for fertilizer use are difficult to obtain at reasonable prices. Domestic nitrogenous tankage is nominally at $4.10 to $4.50 per unit of ammonia ($4.98 to $5.47 per unit N), f.o.b. production point in bulk, but the three major producers are sold up for the entire season. Limited lots of foreign nitrogenous appear occasionally on the market at around $5.50 to $5.75 per unit of ammonia ($6.68 so $6.99 per unit N), c.i.f. Atlantic ports.

Castor Pomace.—Limited supplies have been offered recently for fall and January shipment at $5.50 per unit of ammonia ($6.68 per unit N) in bags, f.o.b. Northeastern production points. This material is guaranteed 5.75 per cent ammonia as compared to the usual guarantee of 6.75 per cent ammonia. A very limited quantity has been offered at $37.50 per ton in bags, minimum 6.75 per cent ammonia.

Dried Ground Blood.—The Chicago market is quiet at around $8.25 to $8.50 per unit of ammonia ($10.02 to $10.33 per unit N), in bulk, with the New York market approximately the same.

Potash.—Movement to consumers continues at a steady pace against contracts, temporarily interrupted from time to time by box car shortages. Production continues at capacity. The price for spot sales is now 42 cents per unit of K_2O, f.o.b. Carlsbad, for bulk muriate.

Ground Cotton Bur Ash.—Supplies in Texas continue considerably short of the production during the past season, with producers reluctant to offer for future shipment.

Phosphate Rock.—Movement to domestic consumers is at seasonal volume. Shortage of sulphuric acid in certain areas is causing decreased shipment of phosphate rock to the affected areas.

Superphosphate.—This market is becoming considerably firmer as the shortage of sulphuric acid is having its effect. Price of sulphuric acid generally has been advanced, resulting in higher prices for superphosphate in many production areas. Demand for triple superphosphate exceeds supply considerably.

Sulphate of Ammonia.—Movement from coke oven production points continues steady, maintaining

(Continued on page 18)

E. RAUH & SONS FERTILIZER CO.
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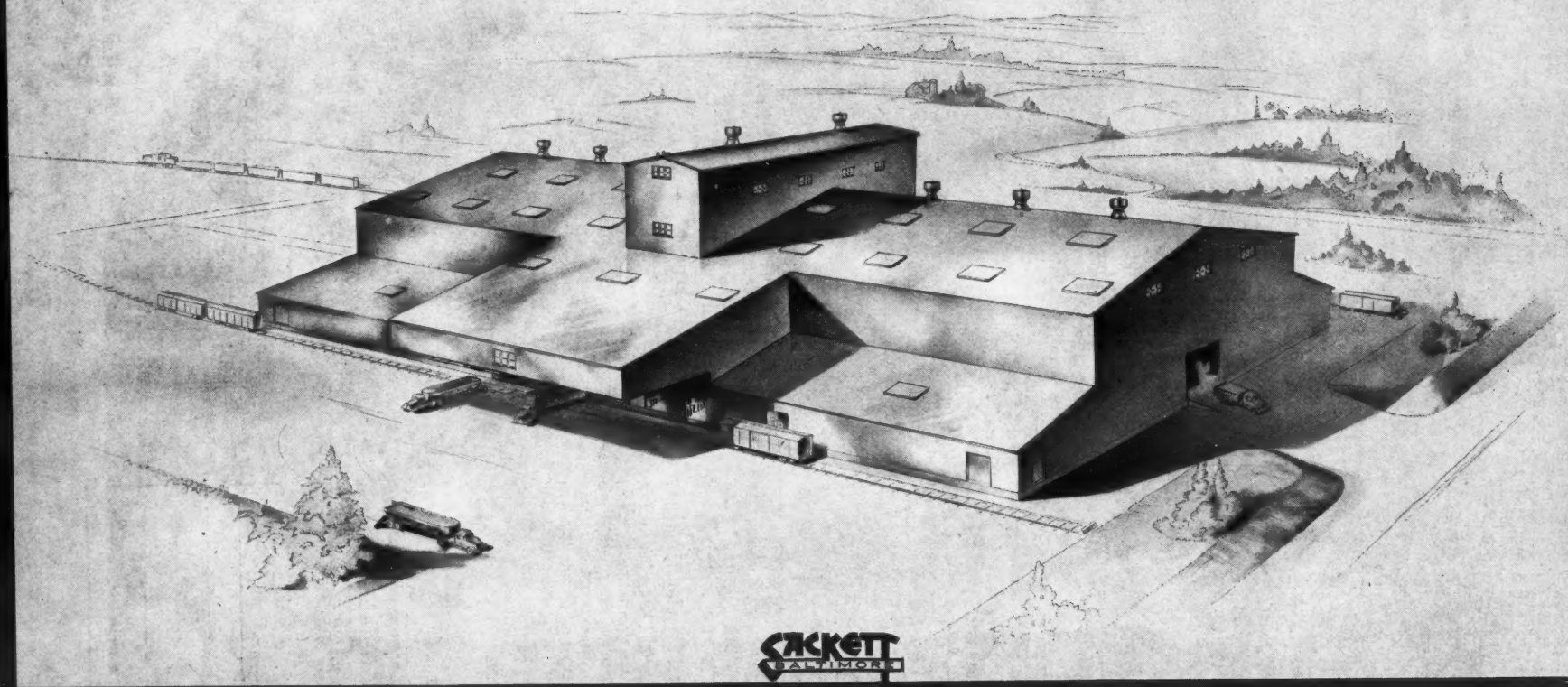

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stock at low levels. Synthetic material for export is scarce and firm with price around $40.00 to $42.00 per ton, f.a.s. Gulf Ports.

Ammonium Nitrate. — Supplies continue scarce both from domestic and foreign sources. Demand is in excess of supply. No recent change in prices has been noted.

Nitrate of Soda.—This market continues firm without any change in prices. Supply is adequate and demand seasonal.

CHICAGO

Little Change in Organics Market. Large Soybean Output Affects Prices of Other Materials

CHICAGO, October 21, 1950

There has not been much change in the midwestern market on animal ammoniates during the past two weeks. Prices are somewhat lower but the decline established has not been as great as was anticipated. Trading conditions remain about the same with buying interest at a minimum, and production is fairly heavy which is augmented by a large potential available supply of soybean meal. In view of existing conditions, it is very improbable that the market will show any improvement and there are some prospects of further weakness.

Ground and sacked meat scraps, 50 per cent protein, range in value from $95.00 to $105.00 per ton and digester tankage, 60 per cent protein, at $100.00 to $110.00 per ton, the range depending upon location of material offered. Dry rendered tankage is quoted at $1.70 to $1.75 per unit of protein delivered. Wet rendered tankage ranges from $8.25 to $8.75 per unit of ammonia ($10.02 to $10.63 per unit N), and dried blood at $8.25 to $8.50 ($10.02 to $10.33 per unit N),. Steamed bone meal, 65 per cent B.P.L., is listed at $75.00 to $80.00 per ton and raw bone meal, 4½–45 per cent, at $70.00 per ton.

A small boy was seated on the curb with a pint of whiskey in his hand reading a gentlemen's magazine and smoking a big cigar. An old lady passed by and asked, "Little boy, why aren't you in school?"

The boy replied, "Damn it lady, I ain't but four."

Better Fertilizer . . .

(Continued from page 14)

"Educational organizations such as agricultural colleges, the agricultural experiment stations and the state extension services are doing a splendid job of rural education, but these organizations are limited in money and personnel, the job is immense, and their efforts are spread clear across the board.

"So it would appear to me," continued Collings, "that if South Carolina farmers, by the thousands, are to be instructed, in a limited length of time, as to the proper use of commercial fertilizers and if they are to be well grounded in the fundamentals of plant nutrition, then vitally interested groups, such as yours, must of necessity come to the aid of the existing governmental agencies. An organization such as the Plant Food Educational Society of South Carolina, could do much to bring about the desired results." The need for education as to the benefits to be derived from wisely used commercial fertilizers and the limitations thereof is not, of course, confined to the state of South Carolina or its neighbors. As a result of the work just beginning by the South Carolina educational group, manufacturers of fertilizers throughout the nation may be encouraged to adopt similar methods.

Professor Collings pointed out that the state experiment stations are the primary sources of the fundamental information that sets the pace for agricultural development. In further defining the functions of the state agencies, Collings told the South Carolina group that the experiment stations are not equipped to fully disseminate information among farmers. A separate organization, the state extension services, are designed to do that. Professor Collings then advised the new association that the best policy it could follow would be to "back up to the hilt" the extension program within its state and "to see to it that this program is brought vividly to the attention of all fertilizer dealers in the state and that these dealers pass on to their farmer clients those sections of the overall

(Continued on page 20)

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Better Fertilizers

(Continued from page 14)

agricultural program that pertain to the proper use of commercial fertilizers."

"There is an educational job to be done among manufacturers, too," stated Collings. He suggested to the plant food group that they make a concerted effort to improve the quality of the fertilizers which they offer for sale to farmers. "There is little point," he said, "in recommending better fertilizer grades or materials to the farmer, should this be advisable, if they are not available on the market." ◆

News Notes *(Continued)*

method, perfected at the Company's Whitemarsh Research Laboratories, that assures an unusually high degree of quality control.

The building itself is being erected by Montgomery Industries, Inc, a group of business men sponsored by the Montgomery Chamber of Commerce, and is being leased to the Company It will be of concrete, brick and steel construction and will include production facilities, warehouse space, rail and truck shipping docks, complete service facilities for employees, and an office.

Production equipment of the latest design is being installed by Pennsalt and will include the most modern available equipment for dust and fume control. The entire plant has been engineered for safety of employees.

J. Drake Watson, formerly technical sales representative for the Southeast in the Agricultural Chemicals Department, has been named District Manager for the area and will make his headquarters at the Montgomery plant.

Richard O. White, formerly superintendent at Pennsalt's Cornwells Heights, Pa., plant, has been appointed superintendent for the new operation.

Distributors Convene

A convention for distributors of the Baughman Manufacturing Company will be held at the Company's factory, Jerseyville, Illinois, Monday, Tuesday and Wednesday, November 6, 7 and 8.

The purpose of the convention is to acquaint distributors first hand with the complete line of Baughman equipment and to outline sales and advertising plans for 1951.

The meeting will close with a banquet Wednesday night, November 8, in the main dining room of Pere Marquette Lodge on the Illinois River.

Baughman manufactures belt, screw and chain and flight conveyors, belt and bucket elevators and self-unloading truck bodies with more than 100 distributors from coast to coast.

Firman Bear Addresses N. E. Soil Conservation Group

"The fertilizer industry represents the most important chemical development, in terms of human values, the world has ever known," according to Dr. Firman E. Bear, president of the Soil Conservation Society of America and chairman of the Soils Department at the New Jersey Agricultural Experiment Station. "But fertilizers alone will not meet the requirements for soils that are producing cultivated crops," he went on. Dr. Bear advocated a program of sod and cover crop rotations and the utilization of wastes from cities to help overcome the organic matter deficiences from which many United States soils suffer.

He spoke before an audience of 75, at the annual meeting of the Southern New England Chapter of the Soil Conservation Society of America, held at the Connecticut Agricultural Experiment Station on October 20th. Dr. C. L. W. Swanson, Chairman of the Southern New England Chapter and head of the Connecticut Station's Soils Department, presided at the meeting.

Stating that we cannot long continue our present wasteful soil practices with impunity, Dr. Bear said that a good grass-legume program would go a long way toward correcting past errors. Such sod and cover crops, he said, help "rebuild the granular structure in cultivated soils, supply organic matter, push this organic matter down deep into the subsoil, and stop erosion." Hand-in-hand with their use, he believed, should go increased utilization of wastes from cities, much of which is now "burned, buried, or dumped into the ocean."

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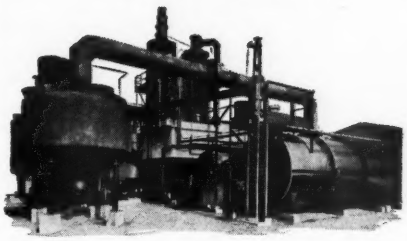

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Briefs

Effectiveness of Insecticides Depends on Application Method

Many complaints that an insecticide is failing to give results have not been due to the failure of the insecticide to kill, but to the failure of the applicator to put it on in the right way. For this reason, county agents are now telling the farmers in their areas that an insecticide is only as good as the application.

In the interests of economical use of insecticides, the farm advisors are telling farmers that "the old days of 'machine gun' tactics should be forgotten and we should revert to the old 'one shot, one buck' method. In other words, make every application yield the best results possible."

"Too often," says one county agent, "the operator of a ground machine gets careless and skips a few rows in the field. Airplane pilots may fail to over-lap swats when applying insecticides or fail to get the edges, depending on drift to take care of these spots. The undusted spots then remain as a source of infestation for the rest of the field." Much of this improper application can be overcome by watching the dusting or spraying operation carefully to make sure that all areas receive a thorough application. Flagmen may be used to aid airplane pilots to overlap the swats.

The fact that in many cases, the so-called lack of killing power of insecticides is later traced to improper application suggests that pesticide manufacturers and distributors may have an educational job to do among their salesmen and customers alike. Clear, simply-worded, and clearly-illustrated instructions should, of course, accompany every container of pest-control poison. As most farmers are likely to mislay separate instruction leaflets, it might be worthwhile—in terms of satisfied customers—to print simplified instructions on the outside of each container and to impress on the customer at the time of purchase the need for carefully following the recommendations of the manufacturer.

Some of the larger firms may find it profitable to issue slide-films, recorded talks, or 16 mm. sound movies on the application of insecticides of various types to different kinds of crops. County agents would undoubtedly welcome the opportunity to present the instructional shows to the farmers in their communities.

Spray-Machine Effectiveness

As a result of tests now under way, scientists at the Washington Agricultural Experiment Station hope to be able to recommend the proper type of machine and the right amount of chemical to use for spraying orchards.

In the tests, fruit trees are sprayed, then a check is made as to the amount and pattern of spray particles on the tree and on the ground. Cover crop treatment is important because of pests such as mites, which develop on the cover crop, then migrate to the trees.

The effectiveness of machine application has never been completely known, because all experimental recommendations up to now have been based on hand-spraying equipment. Hand equipment, however, has been discarded by many orchardists in favor of automatic machines or aircraft.

One big reason why the Washington studies are being stepped up now: A recent order of the State Department of Agriculture limits aerial dusting of organic phosphates, such as parathion and TEPP, because of the possible health hazard from phosphate dusts.

Unintentional Demonstration

While spreading lime on his lespedeza, J. M. Wallace of Rockcastle county, Kentucky, ran out of fertilizer with only half his field treated. As a result, he had an excellent demonstration showing the value of lime. On the five acres where the mineral was used, the lespedeza was 19 inches high by the early part of this month, while it was only 12 inches high where no lime was used.

Reinforced Manure

Customers who use a high percentage of organic fertilizers should be told that it is best to reinforce the active fertilizer content of manure from dairy cattle with 50 pounds of 20% superphosphate per ton. As the average analysis of natural naure contains 10 pounds of nitrogen, 5 pounds of phosphoric acid, and 10 pounds of potash per ton, the addition of the superphosphate in the proportions recommended will give a 10-15-10 fertilizer. The superphosphate also helps to prevent loss of nitrogen.

Some Apple Varieties Pose Parathion Problems

Damage to apple foliage and fruit caused by the use of the insecticide, parathion, on McIntosh and related varieties are the basis for experiments now being con-

(Continued on page 26)

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Calcium Sulphate

(*Continued from page 8*)

The recent investigations of J. L. Haines and associates (*14*) on the importance of calcium in the soil in the formation of healthy root systems should be mentioned. Haines has conclusively shown that on podzolic soils the physiological evidence is that the co-presence of calcium and boron is an essential prerequisite in any soil zone to the healthy activity of plant roots.

The point I am stressing is that perhaps soil acidity, as such, has been unduly stressed as harmful to plant growth, when perhaps the thing to emphasize in such a situation is the calcium deficiency, and not so much the correction with carbonates: the soil exchange complex in such a situation has given up its nutrients—calcium, potassium, ammonium—in e change for hydrogen. The absence of the cations, or the presence of excess hydrogen, is the detrimental factor. Liming has fortunately been beneficial because primarily it supplies calcium, and only secondarily because it furnishes carbonate to neutralize acidity. We may put it this way: deficiency of plant nourishment is the true cause of poor growth on an acid soil.

TABLE II

POUNDS OF CALCIUM OF SOME REPRESENTATIVE CROPS PER TON OF PRODUCT

Crop	*Pounds*
Vetch hay	17.2
Soybeans	4.2
Sweet clover hay	19.0
Alsike clover hay	15.2
White clover hay	24.4
Cow pea hay	36.2
Alfalfa seed	25.2
Alfalfa hay	20.5
Spinach	1.2
Tobacco stalks	12.8
Wheat (Spring)	0.6
Oats	4.4
Corn silage	1.4
Strawberries	2.0
Carrots	1.2
Cauliflower head	2.4
Celery	8.4
Parsnips	1.2
Cabbages	0.8

Source: Morrison, Feeds & Feeding; F. E. Bear; and miscellaneous

Bear and miscellaneous

In addition to its function as an essential plant nutrient, calcium has other beneficial effects. It has been shown by Albrecht and associates (*15*) that calcium mobilizes phosphorus and nitrogen into the crop. That is to say, a plant supplied with calcium will make better use of nitrogen and phosphorus taken into its tissues and will retain more of these elements. This has also been pointed out by research at the Pennsylvania Station (*16*).

Gypsum

We have been considering the beneficial effects of the nutrients calcium and sulphur. Now, let me briefly review some references to the use of gypsum and tie the results in with its calcium and sulphur components.

The following effects of gypsum are accepted generally by soil chemists. Applied as a finely ground material, gypsum acts directly and indirectly as a fertilizer. It furnishes sulphur in the form of SO_3 plant nutrient, and is particularly beneficial to crops such as the cereals, forage hays, legumes, cotton, tobacco, and peanuts. Indirectly it tends to liberate soil reserves of soluble potash by reacting with insoluble potassium silicates. Gypsum can exchange its calcium for potassium and magnesium of the clay-humus complex, thereby also making potash available. The Dutch use this principle as the basis of reclaiming the soils of the Zuiderzee: the calcium of the gypsum is exchanged for the sodium of the clay soil. By stimulating the growth of nitrogen-fixing bacteria, gypsum serves to increase the supply of usable nitrogen. A very old farm use of gypsum is that of mixing it with animal manures: by its reaction the volatile ammonium carbonate is converted to sulphate of ammonia, a more permanent nitrogen compound, thereby reducing losses of this valuable nutrient. The U. S. D. A., Bureau of Plant Industry, has (*12*) estimated that the annual consumption of gypsum in the United States for direct farm use averages close to half a million tons.

The literature on the soil and nutritive effects of gypsum is extensive. The modern record starts with Boussingault, that early French investigator who deserves the gratitude of all soil workers as the true founder of modern agriculture. From 1841 to 1844 he carefully studied the effects of gypsum and was convinced that its beneficial action was due to its calcium. The interest in gypsum which prior to these tests had been raised to a high degree in Germany and in the Pennsylvania Colony (*17*), seemed to subside shortly after these tests, and especially with the introduction of superphosphate in the early 1840's. Since all the crops that had responded so remarkably to gypsum now did as well if not better with superphosphate, the advocates of gypsum slowly lost their market. This is not surprising since the superphosphate was well supplied with gypsum and the combination of phosphate, calcium, and sulphur should give better returns than gypsum alone.

Superphosphate

What is the role played by gypsum in superphosphate? is a good question at this point. To answer it, the Hamburg (Germany) Agricultural Experiment Station, in 1936, made a series of interesting tests which I shall briefly outline.

Four experiments were designed using sulphur-loving crops, like mustard, lupines, and clovers, on four different soils. The fertilizers used were monocalcium phosphate, with and without additions of sulphate in the form of sodium sulphate, to furnish the SO_4-ion in its most effective form; normal superphosphate; and basic slag with and without an addition of gypsum. To get a clear-cut action of the effect of the SO_4-ion, the sulphur contained in the soil was fixed to the barium sulphate form, by means of barium nitrate in half of the experimental rows. The results are given in Table III.

(*See table and continued text on page 23*)

Calcium Sulphate (*Continued from page 23*)

TABLE III

PROPORTIONATE YIELDS OBTAINED WITH SUPERPHOSPHATE
(YIELDS WITHOUT FIXING THE SULPHUR OF THE SOIL = 100)

Sulphur of soil was	*Basic fertilization $K_2O + N$*	*$CaH_4(PO_4)_2$*		*Superphosphate*	*Basic Slag*	
		without	*with*		*without*	*with*
		addition of SO_4 in the form of Na_2SO_4			*addition of SO_4 as gypsum, $CaSO_4.2H_2O$*	
1. Yellow mustard						
Not fixed	20.3	105.6	104.6	100	....	....
Fixed	16.1	83.9	93.4	92.8	86.2	93.8
2. Blue Lupine						
Not fixed	79.8	115.7	113.5	100	....	....
Fixed	52.2	82.6	92.7	94.4	63.5	61.2
3. Crimson Clover						
Not fixed	59.5	98.3	95.9	100	....	....
Fixed	29.2	64.7	70.6	78.1	82.2	86.0
4. Bastard clover						
Not fixed	40.9	98.3	127.2	100	....	....
Fixed	18.6	55.8	101.0	71.8	60.1	84.7
Averages						
Not fixed	50.1	104.5	110.3	100	....	....
Fixed	29.0	71.8	89.4	84.3	73.0	81.4

What do we get? Where the barium tied up the sulphur as barium sulphate, the yields are all lower than those treated the same except for the added barium nitrate.

In the basic fertilization series, the lack of phosphoric acid depressed yields when compared with the monocalcium phosphate only series.

Comparing the series in which the sulphur had been fixed with the monocalcium phosphate series, the increase, due to the addition of sulphate either as the sodium or calcium, was due to the nutrients of the sulphate or perhaps to correction of the harmful effect of barium by means of sulphate.

The series with monocalcium phosphate alone and superphosphate alone is interesting: the average increase in yields of about 12 per cent for superphosphate was due to the calcium sulphate. An equivalent quantity of sodium sulphate, when added to the monocalcium phosphate, gave an average increase of about 5 per cent over the calcium sulphate of the superphosphate.

With the basic slag series we see also that the yields when calcium sulphate was not added were about the same as those for the monocalcium phosphate alone. But by adding calcium sulphate to the slag a beneficial effect ensued amounting to about 11 per cent increase in yields.

In our own country a number of experiment stations have tested the influence of the calcium sulphate of superphosphate on yields. L. G. Willis (*18*) studied the value of gypsum as supplement to a concentrated fertilizer for cotton. He found that the concentrated fertilizers were deficient in some nutrients and believed that exchangeable calcium was a suitable corrective.

The remainder of Dr. Sauchelli's paper, with the list of references and an appendix will be carried in the November 11 issue. Ed.

†Paper presented at the meeting of the American Chemical Society, Division of Fertilizer Chemistry, Chicago, Ill., September 5, 1950.

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Rock Phosphate Compared to Superphosphate

In answering inquiries from Michigan farmers about the value of raw rock phosphate as compared to superphosphate, Jim Porter, Michigan State College extension specialist has this to say:

"Rock phosphate is simply the raw rock containing phosphate and ground to a powder. The superphosphate has been treated chemically to increase its solubility. The treatment makes about half the phosphorus soluble in water and the other half soluble in very weak organic acid. In rock phosphate not more than about two per cent is in soluble form.

"The raw rock phosphate will do better on some crops than others. For instance, alfalfa and sweet clover, grown on soil having enough lime, seem to get the most benefit from it. They can use the insoluble form of phosphate better than other crops. Corn, oats, wheat, and red clover are less able to use the rock phosphate."

A number of experiemnts have been run at Michigan State College on this subject and they indicate that for the dollar invested, even though it costs more per ton, superphosphate will return more profit.

Porter then lists these points:

1. Raw rock phosphate will be most beneficial in soils which are well supplied with lime, organic matter, and potassium, and for the crops of alfalfa and sweet clover.

2. Under these conditions a fall top dressing on alfalfa at 500 to 1000 pounds per acre would be expected to show results next season.

3. This benefit would probably continue for two or three years—maybe longer.

4. The same money invested in superphosphate could be expected to return more in yields.

5. The best time to apply phosphate fertilizer is at the time of seeding, down the drill spout.

falling leaves . . .

Fertilizer Barometer

VERMONT farmers use the brightly-colored leaves of fall to tell when it's time to apply fall fertilizers. Lester Smith, Vermont extension agronomist, says that when the leaves start to turn farmers know it is time to begin conditioning the land to insure better pastures the following year.

Fertilizer should be applied at least a couple of weeks before the grass stops growing, Smith says. Then the roots can take up the fertilizer and store it for early spring growth. The plant that has this food stored in its "cellar" is better able to live through the winter and will be ready to grow when the first warm weather comes along the next spring.

On grass sods, the agronomist advises an application of 300 to 400 pounds of 10–10–10 or 7–7–7. On grass sods with 25–50 per cent legumes, he advises 400 to 600 pounds of 8–16–16 or 5–10–10. On heavy stands of legumes, Smith suggests 600 to 900 pounds of 0–20–20 or 0–14–14. Alfalfa sods should be top-dressed with 600 pounds of 0–19–19–1 which contains borax.

The split-application method is becoming more popular each year, Smith reports. This involves putting on half the above amounts in the fall and the other half after the first crop is taken off in the spring. Then farmers can be sure that all crops will get some potash. When all the fertilizer is put on at one time, the plants will take it up but won't make good use of it and there won't be any available for the second crop, says Smith.

Fertilizer is still one of the best buys for a farmer today, Smith declares. Farmers and the fertilizer industry will be helped, he says, if farmers order next year's supply right away. ◆

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Briefs

(*Continued from page 22*)

ducted at the New York Agricultural Experiment Station at Geneva. The addition of activated charcoal to the spray material gives promise of reducing adverse effects.

Although the comparatively new chemical has been universally acclaimed as an effective insect killer, foliage and fruit damage have been observed on McIntosh, Early McIntosh, Cortland, Macoun, and other related varieties which are produced chiefly in the Northeastern United States.

Injury to actively growing tissue and exposed leaves is most apparent early in the season, even at dosages which are too low for insect control. Leaves which appear after the spray has been applied develop normally, however. Injured leaves show a burning of the margins and parts or all of the leaves, while sunken dark spots occur on the fruit, apparently where droplets of the spray have left heavy deposits. These spots become less noticeable by harvest time.

Early experiments reported by Dr. E. H. Glass in the current issue of "Farm Research" indicate that the use of three or four parts of activated charcoal to one part of actual parathion may counteract the detrimental effects of the insecticide. Before recommendations can be made, however, further tests must be conducted on any possible secondary effects of the charcoal.

1950 Farm Income

Gross U. S. farm income for 1950 is now estimated at $31.5-billion, compared with $32.2-billion last year. With farm production expenses higher than 1949, realized net income may total about $13-billion compared with $14-billion in 1949 and the postwar record of $17.8 billion in 1947.

Phosphates Increase Yields

Marked increase in yields and gains of 40 per cent in phosphorous content in pasture forage have resulted from application of phosphate fertilizers to phosphorous deficient soils in California. In addition, a slight increase in the percentage of protein of the entire forage, noted by Dr. V. V. Rendig, University of California soil scientist who has been investigating phosphorus deficiencies, was attributed by Rendig to the fertilizer which caused general growth stimulation. This in turn increased the proportion of legumes in the forage. Phosphorus deficiency is widespread in the red terrace soils of California where many irrigated pastures have recently been established.

Fertilizing Cover Crops

Winter grazing will be improved if cover crops in Virginia are fertilized in the fall; and spring grazing will get a boost if cover crops are fertilized during the winter. In passing this information on to Virginia farmers, W. C. White, agronomist at Virginia Polytechnic Institute, advises them to use 400 to 600 pounds per acre of 4-16-8, 7-7-7, or 5-10-10 for non-legume crops such as rye grass or small grains. The same amounts, but in the ratios 2-12-12; 0-14-14; or 0-14-7 can be used for legumes such as crimson clover, White says.

When following a heavily fertilized crop, the cover crop may not need additional fertilizer, but that will depend upon the nature of the crop that has been harvested, the amount and type of fertilizer that was used on it, and the type of soil.

Further tips on management of winter cover crops in Virginia have been given in circular number 505, entitled "Winter Cover Crops," published by the Agricultural Extension Service, Blacksburg, Va.

Ten Million Bushels of Corn . . . for Insects

Each year insects destroy over 10,000,000 bushels of the Alabama corn crop. But, by proper harvesting and storage methods plus the use of insecticides, this loss of stored corn from insect pests can be greatly reduced.

Corn should be harvested as soon as it is dry enough to store safely. Also, thoroughly cleaning the crib and spraying the entire inner surface with a five per cent DDT wettable powder spray will materially aid in killing insects that are hiding in the cracks and crevices. The Alabama Polytechnic Institute then recommends that the corn crib be fumigated after it has been tightly sealed. Use of either ethylene dichloride, carbon disulfide, or methyl bromide, according to directions on the container, is suggested for this purpose.

USDA 'Hopper Survey

Farmers in New Mexico have reported highly satisfactory results in the control of grasshoppers by using chlordane and toxaphene. That is part of the information reported by the USDA which has just completed a survey of the grasshopper pest in New Mexico.

Information obtained in both the adult and egg survey will serve as a basis for the 1951 infestation forecast. Some time this winter, the New Mexico Extension Service will prepare a map of the state showing the location and severity of the grasshopper situation.

Many farmers were reported to have suffered unnecessary losses because they didn't start control operations early enough if at all. "Experience gained this year should lead to a more effective program next year," said L. H. Moore, extension entomologist for the USDA.

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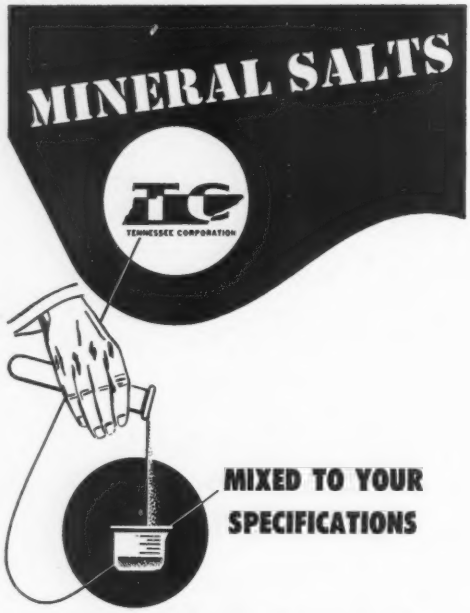

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of AMERICAN FERTILIZER & ALLIED CHEMICALS, published bi-weekly at Philadelphia, Pa., for October 1, 1950

1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Name of	Post-office Address
Publisher, Sam Lewis Veitch	317 N. Broad St., Phila., Pa.
Editor, A. A. Ware	317 N. Broad St., Phila., Pa.
Managing Editor, None	
Business Manager, A. A. Ware	317 N. Broad St., Phila., Pa.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.

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3. That the known bondholders, mortgagees and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above was (This information is required from daily, weekly, semi-weekly, and tri-weekly newspapers only.)

A. A. WARE, Editor.

Sworn to and subscribed before me this 19th day of Sept., 1950

A. F. WALSH
Notary Public

(My commission expires March 5, 1953.)

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Barrett Div., Allied Chemical & Dye Corp., New York City
Commercial Solvents Corp., New York City
Lion Oil Co. El Dorado, Ark.
Phillips Chemical Co., Bartlesville, Okla
Spencer Chemical Co., Kansas City, Mo.

AMMONIUM NITRATE
Lion Oil Co., El Dorado, Ark.
Phillips Chemical Co., Bartlesville, Okla.
Spencer Chemical Co., Kansas City, Mo

BAG MANUFACTURERS—BURLAP
Bemis Bros. Bag Co., St. Louis, Mo.
Mente & Co. Inc., New Orleans, La.
Virginia-Carolina Chemical Corp., Richmond, Va.

BAG MANUFACTURERS—Cotton
Bemis Bro. Bag Co., St. Louis, Mo.
Mente & Co. Inc., New Orleans, La.
Virginia-Carolina Chemical Corp., Richmond, Va

BAG MANUFACTURERS—Paper
Arkell & Smiths, Canajoharie, N. Y.
Bemis Bro. Bag Co., St. Louis, Mo.
International Paper Co., Bagpak Div., New York City
Jaite Company, The, Jaite, Ohio
Kraft Bag Corporation, New York City
Mente & Co. Inc., New Orleans, La.
Raymond Bag Co., Middletown, Ohio
St. Regis Paper Co., New York City
Virginia Carolina Chemical Corp,. Richmond, Va.

BAGS—Dealers and Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
McIver & Son, Alex. M., Charleston, S. C.

BAG CLOSING MACHINES
International Paper Co., Bagpak Div., New York City
St. Regis Paper Co., New York City

BAG PRINTING MACHINES
Schmutz Mfg. Co., Louisville, Ky.

BAGGING MACHINES—For Filling Sacks
Atlanta Utility Works, The, East Point, Ga.
St. Regis Paper Co., New York City
Sackett & Sons Co., The A. J. Baltimore, Md.
Sturtevant Mill Company, Boston, Mass.

BONE PRODUCTS—BONE BLACK
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davidson Commission Co., The, Chicago, Ill.
Jackle, Frank R., New York City
McIver & Son, Alex M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

BORAX AND BORIC ACID
American Potash and Chem. Corp., New York City

BROKERS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davidson Commission Co., The, Chicago, Ill.
Jackle, Frank R., New York City
Keim, Samuel D., Philadelphia, Pa.
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

BUCKETS—For Hoists, Cranes, etc.
Hayward Company, The, New York City

BUCKETS—Elevator
Baughman Manufacturing Co., Jerseyville, Ill.
Link-Belt Company, Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.

CARS AND CART
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.

CASTOR POMACE
McIver & Son, Alex. M., Charleston, S. C.

CHEMICALS
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Barrett Div., Allied Chemical & Dye Corp., New York City
Commercial Solvents Corp., New York City
Davison Chemical Corporation, Baltimore, Md.
International Minerals & Chemical Corporation, Chicago, Ill.
Lion Oil Company, El Dorado, Ark.
Koppers Company Inc., Tar Products Div., Pittsburgh, Pa.
McIver & Son, Alex. M., Charleston, S. C.
Phillips Chemical Co., Bartlesville, Okla.
Spencer Chemical Co., Kansas City, Mo.
United States Steel Corp., New York City
Virginia-Carolina Chemical Corp., Richmond, Va.
Woodward & Dickerson, Inc., Philadelphia, Pa.
Woodward Iron Company, Woodward, Ala.

CHEMISTS AND ASSAYERS
Gascoyne & Co., Baltimore, Md.
Shuey & Company, Inc., Savannah, Ga.
Wiley & Company, Baltimore, Md.

CONDITIONERS
Jackle, Frank R., New York City
Keim, Samuel D., Philadelphia, Pa.
McIver & Son, Alex. M., Charleston, S. C.
National Lime & Stone Co., Findlay, Ohio
Quakers Oats Company, Chicago, Ill.
Summers Fertilizer Co., Baltimore, Md.

COTTONSEED PRODCUTS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Jackle, Frank R., New York City
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

DRYERS
Sackett & Sons Co., The A. J., Baltimore, Md.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind
Sturtevant Mill Company, Boston, Mass.
Titlestad Corporation, Nicolay, New York City

FERTILIZER (Mixed) MANUFACTURERS
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Davison Chemical Corporation, Baltimore, Md.
International Minerals & Chemical Corporation, Chicago
Southern States Phosphate & Fertilizer Co., Savannah, Ga.
Summers Fertilzer Co., Baltimore, Md.
Virginia-Carolina Chemical Corp., Richmond, Va.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Jackle, Frank R., New York City
McIver & Son, Alex. M., Charleston, S. C.
Summers Fertilizer Co., Baltimore, Md.
Woodward & Dickerson, Inc., Philadelphia, Pa.

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Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore ,Md.
Stedman Foundry and Mach. Works, Aurora, Ind.
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Baker & Bro., H. J., New York City
Southern States Phosphate & Fertilizer Co., Savannah, Ga.
Woodward & Dickerson, Inc., Philadelphia, Pa.

INSECTICIDES
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LEAD BURNERS
Southern Lead Burning Co., Atlanta, Ga.

LIMESTONE
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Ashcraft-Wilkinson Co., Atlanta, Ga.
McIver & Son, Alex. M., Charleston, S. C.
National Lime & Stone Co., Findlay, Ohio

LOADERS—Car and Wagon
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Link-Belt Company, Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making and Handling
Atlanta Utility Works, The, East Point, Ga.
Chemical Construction Corp., New York City
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Ammoniating
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, The, East Point, Ga.
Bradley Pulverizer Co., Allentown, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Material Handling
Atlanta Utility Works, The, East Point, Ga.
Baughman Manufacturing Co., Jerseyville, Ill.
Hayward Company, The, New York City
Hough Co., The Frank G., Libertyville, Ill.
Link-Belt Company, Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Mixing, Screening and Bagging
Atlanta Utility Works, The, East Point, Ga.
Link-Belt Company, Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Power Transmission
Link-Belt Company, Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Superphosphate Manufacturing
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MANGANESE SULPHATE
McIver & Son, Alex. M., Charleston, S. C.

MINOR ELEMENTS
Tennessee Corporation, Atlanta, Ga.

MIXERS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

NITRATE OF SODA
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Barrett Div., Allied Chemical & Dye Corp., New York City
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.

NITROGEN SOLUTIONS
Barrett Div., Allied Chemical & Dye Corp., New York City
Lion Oil Company, El Dorado, Ark.
Phillips Chemical Co., Bartlesville, Okla.
Spencer Chemical Co., Kansas City, Mo.

NITROGENOUS ORGANIC MATERIAL
American Agriculture Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davidson Commission Co., The, Chicago, Ill.
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City
McIver & Son, Alex. M., Charleston, S. C.
Northern Chemical Industries, Inc., Searsport, Me
Summers Fertilizer Co., Baltimore, Md.
Woodward & Dickerson, Inc., Philadelphia, Pa.

NOZZLES—Spray
Monarch Mfg. Works, Philadelphia, Pa.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davison Chemical Corporation, Baltimore, Md.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Virginia-Carolina Chemical Corp., Richmond, Va.

PLANT CONSTRUCTION—Fertilizer and Acid
Atlanta Utility Works, The, East Point, Ga.
Chemical Construction Corp., New York City
Monsanto Chemical Co., St. Louis, Mo.
Sackett & Sons Co., The A. J., Baltimore, Md.
Southern Lead Burning Co., Atlanta, Ga.
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Sturtevant Mill Company, Boston, Mass.
Titlestad Corporation, Nicolay, New York City

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
International Minerals & Chemical Corporation, Chicago, Ill
Jackle, Frank R., New York City
McIver & Son, Alex M., Charleston, S. C.

POTASH SALTS—Manufacturers
American Potash and Chemical Corp., New York City
Potash Co. of America, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
United States Potash Co., New York City

PRINTING PRESSES—Bag
Schmutz Mfg. Co., Louisville, Ky.

REPAIR PARTS AND CASTINGS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman Foundry and Mach. Works, Aurora, Ind.

SCALES—Including Automatic Bagging
Atlanta Utility Works, The, East Point, Ga.
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- Universal Vibrating Screen Co., Racine, Wis.

SEPARATORS—Air
- Sackett & Sons Co., The A. J., Baltimore, Md.
- Sturtevant Mill Co., Boston, Mass.

SPRAYS—Acid Chambers
- Monarch Mfg. Works, Inc., Philadelphia, Pa.

SULPHATE OF AMMONIA
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- Ashcraft-Wilkinson Co., Atlanta, Ga.
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- United States Steel Corp., New York City
- Woodward & Dickerson, Inc., Philadelphia, Pa.
- Woodward Iron Company, Woodward, Ala.

SULPHUR
- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Texas Gulf Sulphur Co. New York City

SULPHURIC ACID
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SUPERPHOSPHATE
- American Agricultural Chemical Co., New York City
- Armour Fertilizer Works, Atlanta, Ga.
- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Baker & Bro., H. J., New York City
- Davison Chemical Corporation, Baltimore, Md.
- International Minerals & Chemical Corporation, Chicago, Ill.
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- U.S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
- Virginia-Carolina Chemical Corp., Richmond, Va.

SUPERPHOSPHATE—Concentrated
- Armour Fertilizer Works, Atlanta, Ga.
- International Minerals & Chemical Corporation, Chicago, Ill.
- U.S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
- Virginia-Carolina Chemical Corp., Richmond, Va.

TANKAGE
- American Agricultural Chemical Co., New York City
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- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Baker & Bro., H. J., New York City
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- Jackle, Frank R., New York City
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